

CLAIMS

1. A method of increasing the efficiency of a system including
2 a vapor compression cooling cycle and having an evaporator with an inlet
connected to an outlet of a gas cooler and an outlet connected to the inlet
4 of a compressor, the compressor having an outlet connected to an inlet of
the gas cooler and a suction line heat exchanger having two fluid flow
6 paths in heat exchange relation with one another with one flow path being
located between the evaporator inlet and the compressor outlet and the
8 other flow path being located between the evaporator outlet and the com-
pressor inlet, and a refrigerant in said system that may exist as a vapor, a
10 liquid or a mixture of vapor and liquid whose quality at a given point is
defined as the weight ratio of the mass of refrigerant vapor to the com-
12 bined mass of refrigerant vapor and liquid refrigerant at the given point,
including the steps of:

- 14 (a) introducing refrigerant into said other flow path of said
suction line heat exchanger at a quality less than 1; and
16 (b) introducing refrigerant that has passed through said
second flow path into said compressor inlet at a quality
18 that is substantially equal to 1.

2. The method of claim 1 wherein said system is character-
ized by the presence of an accumulator downstream of said evaporator
outlet and upstream of said other flow path.

-19-

3. The method of claim 2 wherein said accumulator is characterized by a housing including a liquid refrigerant section and a refrigerant vapor section, a liquid outlet connected to said liquid refrigerant section, a vapor outlet connected to said refrigerant vapor section and a junction whereat said outlets are connected to each other to said other flow path.

4. The method of claim 3 wherein said system is further characterized by a flow restrictor disposed between said vapor outlet and said junction.

5. The method of claim 4 wherein said flow restrictor is a valve.

6. The method of claim 2 wherein said accumulator includes a housing having a liquid refrigerant section and a refrigerant vapor section and an outlet conduit therein which is connected to said other flow path, said conduit including a first opening in said liquid refrigerant section and upstream of a second opening in said refrigerant vapor section.

7. The method of claim 1 wherein there is an accumulator between said evaporator outlet and said other flow path, and step (a) includes the step of introducing refrigerant from said accumulator into said other flow path at a quality less than 1.

-20-

2 8. The method of claim 1 wherein said system includes an
4 accumulator interposed between said other flow path and said compressor
4 inlet and step (a) is followed by and step (b) is preceded by the step (a1) of
4 introducing refrigerant that has passed through said other flow path into
4 said accumulator.

2 9. A method of increasing the efficiency of a system including
4 a vapor compression cooling cycle and having an evaporator with an inlet
4 connected to an outlet of a gas cooler and an outlet connected to the inlet
6 of a compressor, the compressor having an outlet connected to an inlet of
6 the gas cooler and a suction line heat exchanger having two fluid flow
8 paths in heat exchange relation with one another with one flow path being
8 located between the evaporator inlet and the compressor outlet and the
10 other flow path being located between the evaporator outlet and the com-
12 pressor inlet, and a refrigerant in said system that may exist as a vapor, a
14 liquid or a mixture of vapor and liquid whose quality at a given point is
14 defined as the weight ratio of the mass of refrigerant vapor to the com-
16 bined mass of refrigerant vapor and liquid refrigerant at the given point, and
16 an accumulator interposed between said other flow path and said compres-
18 sor inlet, the steps of:

- 16 (a) introducing refrigerant having a quality of less than 1
16 into said other flow path from said evaporator outlet;
18 (b) discharging refrigerant from said other flow path into
18 said accumulator; and

- 20 (c) introducing refrigerant from said accumulator having a quality substantially equal to 1 into said compressor inlet.

2 10. A method of increasing the efficiency of a system including a vapor compression cooling cycle and having an evaporator with an inlet connected to an outlet of a gas cooler and an outlet connected to the 4 inlet of a compressor, the compressor having an outlet connected to an inlet of the gas cooler and a suction line heat exchanger having two fluid 6 flow paths in heat exchange relation with one another with one flow path being located between the evaporator inlet and the compressor outlet and 8 the other flow path being located between the evaporator outlet and the compressor inlet, and a refrigerant in said system that may exist as a vapor, a liquid or a mixture of vapor and liquid whose quality at a given point 10 is defined as the weight ratio of the mass of refrigerant vapor to the combined mass of refrigerant vapor and liquid refrigerant at the given point, and 12 an accumulator interposed between said other flow path and said evaporator outlet, including the steps of:

- 14 (a) introducing refrigerant from said evaporator outlet into 16 said accumulator;
- 18 (b) discharging refrigerant having a quality less than 1 from 18 said accumulator into said other flow path; and
- 20 (c) introducing refrigerant having a quality substantially equal to 1 from said other flow path into said compressor inlet.

-22-

2 11. The method of claim 10 wherein said accumulator includes both liquid refrigerant and refrigerant vapor and step (b) is performed by the step (b1) of entraining or educting liquid refrigerant from said accumulator by refrigerant vapor exiting said accumulator to said compressor inlet.

2 12. The method of claim 10 wherein step (b1) is performed within the accumulator.

2 13. The method of claim 11 wherein step (b1) is performed downstream of the accumulator.

2 14. A refrigeration system including a compressor having an inlet and an outlet, a gas cooler connected to said outlet to cool compressed refrigerant received from the compressor, an evaporator connected to the gas cooler for receiving cooled, compressed refrigerant therefrom, an accumulator connected to the evaporator to receive expanded refrigerant therefrom and to the compressor inlet and a suction line heat exchanger having a first refrigerant flow path interposed between the gas cooler and the evaporator and a second refrigerant flow path in heat exchange relation with said first refrigerant flow path and interconnecting the accumulator and the compressor inlet, and characterized by the accumulator including an inlet connected to the evaporator, a housing, including said accumulator inlet, for receipt of refrigerant in vapor, liquid or vapor/liquid form, a first housing outlet located to allow refrigerant vapor to exit the housing and a

-23-

14 second outlet located to allow liquid refrigerant to exit the housing, said first and second outlets being connected to said second flow path.

2 15. The refrigeration system of claim 14 wherein said first and second outlets include different openings in a single tube.

2 16. The refrigeration system of claim 15 wherein said tube is a J or U-shaped tube located in said housing and having a short leg and a long leg with said first outlet being at or adjacent to an upper end of said short leg and said second outlet being one or more openings in said long leg and located vertically below said first outlet.

2 17. The refrigeration system of claim 16 further including a bight interconnecting lower ends of said short and long legs, and a lubricant exit hole in said bight vertically below said second outlet.

2 18. A refrigeration system including:
4 a compressor having an inlet and an outlet;
6 a gas cooler connected to said compressor outlet to cool compressed refrigerant received from the compressor;
8 an evaporator connected to the gas cooler for receiving cooled, compressed refrigerant therefrom;
an accumulator connected to said compressor inlet for delivering refrigerant at a quality substantially equal to 1 thereto; and

10 a suction line heat exchanger in said system having a first
refrigerant flow path interconnecting said gas cooler and said evaporator,
and a second refrigerant flow path in heat exchange relation with said first
12 refrigerant flow path and interconnecting said evaporator and said accumu-
lator;

14 said system, including said evaporator, being constructed to
deliver refrigerant from said evaporator to said second refrigerant flow path
16 at a quality less than 1.

19. A refrigeration system including:

2 a compressor having an inlet and an outlet;
4 a gas cooler connected to said compressor outlet to cool
compressed refrigerant received from the compressor;
6 an evaporator connected to the gas cooler for receiving
cooled, compressed refrigerant therefrom;
8 a suction line heat exchanger in said system having a first
refrigerant flow path interconnecting said gas cooler and said evaporator,
and a second refrigerant flow path in heat exchange relation with said first
10 refrigerant flow path and interconnecting said evaporator and said compres-
sor inlet; and

12 said system, including said evaporator, being constructed to
deliver refrigerant from said evaporator to said second refrigerant flow path
14 at a quality less than 1, and from said second refrigerant flow path to said
compressor inlet at a quality substantially equal to 1.

-25-

20. A refrigeration system including:

2 a compressor having an inlet and an outlet;

4 a gas cooler connected to said compressor outlet to cool

6 compressed refrigerant received from the compressor;

8 an evaporator connected to the gas cooler for receiving

10 cooled, compressed refrigerant therefrom;

12 an accumulator connected to said evaporator to receive refrigerant therefrom; and

14 a suction line heat exchanger in said system having a first refrigerant flow path interconnecting said gas cooler and said evaporator and a second refrigerant flow path in heat exchange relation with said first refrigerant flow path and interconnecting said accumulator and said compressor inlet and receiving refrigerant from the accumulator at a quality less than 1 and delivering the refrigerant to the compressor inlet at a quality substantially equal to 1.

21. The refrigeration system of claim 20 wherein the accumula-

2 tator is a housing having an intended level of liquid refrigerant and a refrigerant vapor space above said intended liquid level of refrigerant, a first outlet from said accumulator disposed above said intended level of liquid refrigerant and a second outlet from said accumulator below said intended level of liquid refrigerant, said first and second outlets being in fluid communication with each other and with said compressor inlet.

-26-

2 22. The refrigeration system of claim 21 wherein said second outlet is disposed in a wall of said housing separate from said first outlet.

2 23. The refrigeration system of claim 21 wherein said accumulator includes a tube within said housing and both said outlets comprises respective inlet ports in said tube.

2 24. The refrigeration system of claim 23 wherein the inlet port defining said first outlet is upstream of the inlet port defining said second outlet.

2 25. The refrigeration system of claim 24 wherein said tube is a J or U-shaped tube having a first leg having said first outlet therein at a location above said intended level of liquid refrigerant and a second leg connected to said first leg by a bight and having said second outlet below said intended level of liquid refrigerant.

2 26. The refrigeration system of claim 25 wherein said accumulator includes an intended level of system lubricant below said intended level of refrigerant liquid and said bight is located below said intended level of system lubricant and includes a system lubricant inlet port therein.